

Review of the West Indian *Astraptus xagua* (Lucas) complex (Hesperiidae: Eudaminae) with the description of a new subspecies from the Bahamas

STEPHEN R. STEINHAUSER^{1†}, JACQUELINE Y. MILLER^{1*}, NICK GRISHIN^{1,2}

¹McGuire Center for Lepidoptera and Biodiversity, Florida Museum of Natural History, University of Florida, 3215 Hull Road, UF Cultural Plaza, P. O. Box 112710, Gainesville, Florida 32611-2710

²Howard Hughes Medical Institute and Departments of Biophysics and Biochemistry, University of Texas Southwestern Medical Center, 5323 Harry Hines Blvd., Dallas, Texas 75390-9050

† Deceased 11 August 2007

jmillier@lmnh.ufl.edu

Abstract. *Astraptus xagua* (Lucas) is one of six species within the genus recorded from Cuba, Hispaniola, and the Bahamas in the West Indies. Although Steinhauser and J.Y. Miller completed a review of *Astraptus* based on morphological characters, the advent of molecular phylogenetic analysis provides further insight into the current status of the *Astraptus xagua* complex. We reinstate *A. christyi* (Sharpe) as a species-level taxon based on the differences in genitalia and *COI* barcodes, and describe a new subspecies, *A. xagua harveyi* Clench, Steinhauser and J. Y. Miller, type locality North Andros Island, Bahamas. Thus, the *A. xagua* complex consists of two species, one of which is divided into two subspecies.

Key words: Bahamas, neotropical, *COI*, genitalia.

Resumen. *Astraptus xagua* (Lucas) es una de las seis especies dentro del género registrado para Cuba, la Española, y las Bahamas en las Indias Occidentales. Aunque Steinhauser y J.Y. Miller completaron un examen de *Astraptus* basado en caracteres morfológicos, el advenimiento del análisis filogenético molecular proporciona información sobre el estado actual de la especie del complejo *Astraptus xagua*. Restablecemos *A. christyi* (Sharpe) como especie basados en las diferencias en los genitales y el *COI*, códigos de barras y describimos una nueva subespecie *A. xagua harveyi* Clench, Steinhauser y J. Y. Miller cuya localidad tipo es el norte de la isla de Andros, en las Bahamas. Así, el complejo *A. xagua* consta de dos especies, una de las cuales se divide en dos subespecies.

Palabras clave: Bahamas, neotropical, *COI*, genitalia.

INTRODUCTION

The genus *Astraptus* Hübner includes some very showy, robust-bodied skippers that are geographically distributed throughout the southern United States, Central and South America in addition to the West Indies with more than 26 species described thus far.

* Corresponding author

Received: 14 June 2016

Accepted: 9 February 2017

Copyright: This work is licensed under the Creative Commons Attribution-NonCommercial-NoDerivs 3.0 Unported License. To view a copy of this license, visit <http://creativecommons.org/licenses/by-nc-nd/3.0/> or send a letter to Creative Commons, 171 Second Street, Suite 300, San Francisco, California, 94105, USA.

This genus is distinguished by the narrow costal fold on the male forewing and the antennae extending along approximately one half of the forewing length with tails on the hindwing absent in the six species present the West Indies. The genus has been reviewed in whole or in part by Lindsey (1925), Williams and Bell (1933), W. H. Evans (1952), and more recently by Pelham (2008), Warren et al. (2009) and Mielke (2005) in addition to Steinhauser (1986, 1989), and Steinhauser and Miller (unpublished ms 2001 circa 2004). Although we completed a rigorous analysis of the genus based on morphological treatment, it became obvious that with the number of cryptic species discovered by Herbert et al. (2004) and additional discussions by A. V. Z. Brower (2005) that further analyses would be required for a taxonomic revision.

Astraptus xagua (Lucas) currently includes two formally described subspecies, *A. x. xagua* and *A. xagua christyi* (Sharpe). Another potential subspecies has been known since Donald J. Harvey and subse-

quently Clench (1977) collected it on North Andros 40 years ago. *Astraptus xagua* is bivoltine in Hispaniola and Cuba with most records in December to January in addition to June and July (Smith et al 1994; Matthews et al. 2012). However, the emergence patterns are variable with the specimens collected on North Andros in August and November and also observed but not collected in May and June. The advent of molecular phylogenetic analysis now provides further insight into the current status of *Astraptus xagua* and associated subspecies. The *Astraptus xagua* complex is reviewed here based on both morphological characters and molecular analysis to further delineate the current taxa.

MATERIALS AND METHODS

Specimens examined in this study are deposited in the collections of the McGuire Center for Lepidoptera and Biodiversity. Additional comparative material was examined from the American Museum of Natural History, Carnegie Museum of Natural History, National Museum of Natural History (Smithsonian Institution), and The Natural History Museum, London.

Male and female genitalia were macerated in 10% KOH, dissected and cleared in 70% ethanol prior to permanent storage in glycerin vials. Terminology for wing venation follows the modified Comstock-Needham system described by L. D. Miller (1970). Forewing length is measured from the base of the wing to the end of the fringe at the apex; width is measured normal to the costa from the fringe at the end of the tornus. Nomenclature for the genitalia follows that of Klotz (1956).

Standard COI barcodes (658-bp 5' segment of mitochondrial *cytochrome oxidase subunit I*) were obtained from 14 specimens. DNA was extracted from a single leg and processed in the Grishin lab using Macherey-Nagel (MN) NucleoSpin R tissue kit according to the protocol described (Cong & Grishin 2014). Special primers developed for Eudaminae were used. Newly generated sequences and accompanying data were submitted to GenBank and received accession numbers (KY659594-KY659602). *Astraptus naxos* (Hewitson 1867), a continental species which is distributed in Brazil, was used as the outgroup and for comparative morphological examination of the species currently within the *Astraptus xagua* complex.

RESULTS

Astraptus xagua xagua (Lucas, 1857)

Figures male 1-2; genitalia 13 a-i; female 3-4, genitalia 17

Eudamus xagua Lucas, 1857

= *Goniloba malefida* Herrich-Schaffer, 1862

MALE: Averaged 23.20 x 12.70 mm in five males measured, varying from 22.5 x 12 to 24 x 13 mm.

Dorsal: Forewing with narrow costal fold; ground color black-brown, basal third shiny cerulean blue; no hyaline spots. Hindwing same black-brown as forewing, basal third to half shiny cerulean blue.

Ventral: Forewing ground color black-brown on basal half, especially below cell, in Cu_2 -2A and as a vague darker postdiscal band beyond and above discal cell; slightly paler brown forewing distad, much paler along anal margin; basal third shiny cerulean blue above Cu_2 , reaching to origin of Cu_1 , but does not reach white spots at mid-costa in costal cell; in $Sc-R_1$, this latter spot may be missing. Hindwing: Similar mottled dark brown as forewing, may be slightly darker basally, but otherwise unmarked. Fringes concolorous.

Head, thorax and abdomen black-brown, covered with shiny cerulean blue hair scales and setae above. Palpi black above, pale yellow beneath; pectus pale yellow; legs dark brown, forelegs overscaled whitish on posterior; mid and hind legs overscaled whitish along inner margins. Mid and hind tibiae smooth; mid tibiae with single pair of spurs, hind tibiae with two pairs. Antennae: nudum below, beige shading to gold average 25.0 segments (n=4), range 24 to 26, with five to seven segments on the club.

Genitalia (Figs:13 a-i) similar to *Astraptus naxos* (Figs. 16a-i) but overall smaller and with the following differences: The valvae are asymmetrical but more nearly equal in length as in *fulgurator* and *fulgor*, rather than as in *naxos* and *paros*, based on the material available. The process of the cucullus is spinous with the posterior of cucullus sharply pointed; ampulla is also reduced. There is an elongate lightly sclerotized band ventral to costal margin in *Astraptus x. xagua*. Aedeagus with several internal cornuti similar to a brush and the sclerotized margins with minute spicules.

FEMALE: Similar to male but slightly larger (forewing averaged 27.00 x 14.33 (n=6), range 25.5 x 13.5 to 27.5 x 15), with shiny cerulean blue area somewhat reduced on the dorsal surface. The ventral forewing white costal spots may be absent, but generally enlarged or there may be an additional apical cell spot. The antennal nudum averaged 25.83 segments (n=6), range 23 to 28 segments, with six to eight segments on the club.

Genitalia (Fig. 17 a) with general configuration as in *A. naxos* (Figs. 20 a, b) but slightly reduced in size. Lamella postvaginalis moderately sclerotized with central indentation along posterior margin and a series of erect setae and scales which are longer around the indentation; lamella postvaginalis shades paler toward the lamella antevaginalis; membranous area above the lightly sclerotized bar of the antrum leads to the membranous ductus bursae with the origin of the ductus seminalis dextral; corpus bursae bulbous as opposed to slightly elongate in *naxos* and length of paired signa spiculate and slightly reduced; corpus bursae length approximately one half length of ductus bursae.

Specimens examined. 4♂ 1♀, CUBA: Guantanamo ex colln. Le Mout, A. C. Allyn Acc. 1968-1; genit preps SRS 701, 702; 1♂ CUBA NFD; 1♂ CUBA: GUANTANAMO: 2 km W Yateritas; sea level; 29.vi.1994, L. D. & J. Y. Miller, L. R. Hernandez, sta. 1994-28,

Figures 1-12 (Opposite page). Adult specimens of *Astraptus x. xagua*: 1) ♂ dorsal, 2) ♂ ventral, 3) ♀ dorsal, 4) ♀ ventral (LEP-34276, JYM 7651); 5) *Astraptus xagua harveyi* Holotype ♂ dorsal, 6) Holotype ♂ ventral; 7) Paratype ♀ dorsal, 8) ♀ ventral (LEP-34276); *Astraptus christyi* 9) ♂ dorsal, 10) ♂ ventral; *Astraptus naxos*, 11) ♂ dorsal, 12) ♂ ventral.



1



3



5



2



4



6

CUBA: SANTIAGO de CUBA
Purgos Nue. Orad Piedra, 1100-1200 m
dorsal form; Nov. 1960; LD & TY Miller,
MJ Hixon & LH Hernandez etc. 1950-12

Allyn Museum
Aug. 1990-14
Allyn Museum Photo
No. 990909-27A, 28A

CUBA: GUANTANAMO
GTMO Naval Base, site 12,
E. of Sherman Ave.
19.91661, -75.132414
25.I.2012 D. Matthews &
T. Lott

GTMO-LEP Inventory
D. Matthews
MGCL Accession
2012.2

MGCL 170980
McGuire Center for Lepidoptera
& Biodiversity, FLORIDA, UF

nectaring on *Meibomia
fomentosa*

NORTH ANDROS I.
Nicolls Town
11.viii.1976
BAHAMA IDS
leg. D. Harvey

photo
11. XI. 74
np + w

Holo Type No.
684
Carn. Mus. Ent.

Allyn Museum Photo
No. 990909-17A, 18A

1 cm



7



9



11



8



10



12

DNA voucher
LEP-34276

NORTH ANDROS I.
Nicolls Town
15.viii.1976

BAHAMA IDS
leg. D. Harvey



PARATYPE ♀
*Euthymelic
xagua harveyi*
S. R. Steinhauser

genitalia view
M-7651
Jacqueline Y. Miller

PARATYPE ♀
*Astraptes
xagua harveyi*
H. Clench, S. R. Steinhauser
J. Y. Miller

Allyn Museum Photo
No. 990909-1720A

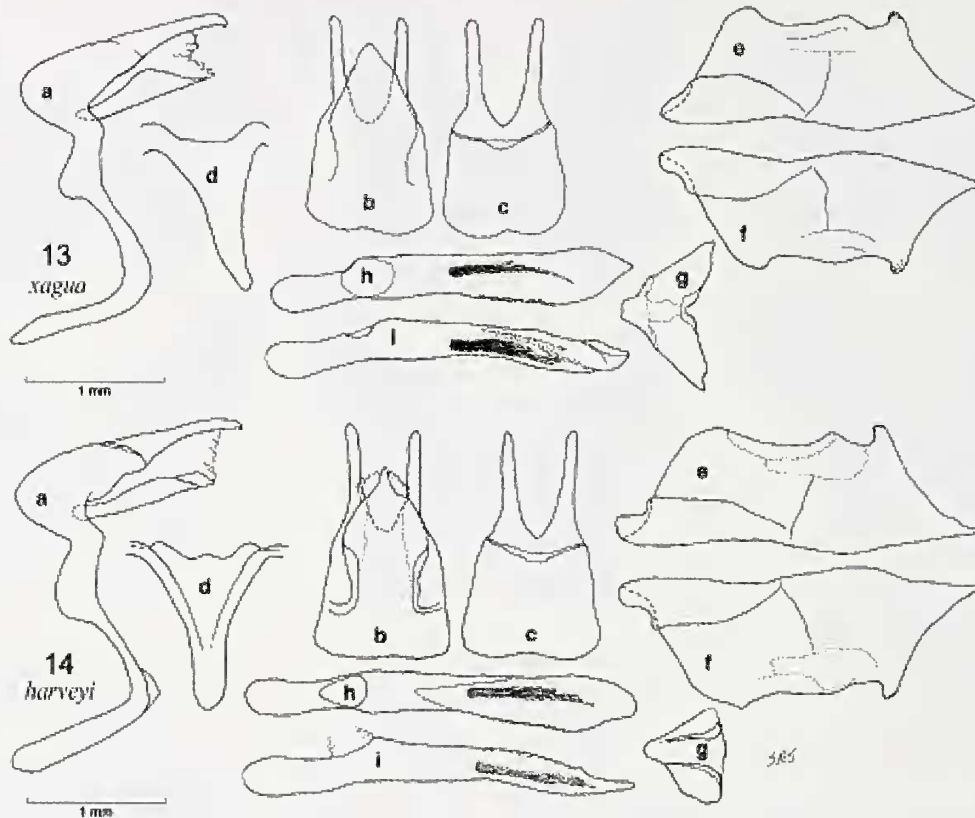
DNA voucher
LEP-16685

19 Km S of Jamboca
La Vega Province
DOMINICAN REPUBLIC
6/23/02 T.C. Emmel

FSCA
Florida State Collection
of Arthropods

BRASIL: RIO de JANEIRO
Sd. do Botica, 1500 m
2.1.1976; C.J. Castilhos

Allyn Museum
Aug. 1973



Figures 13-14. (Scale line = 1 mm) 13 a-i) Male genitalia *Astraptetes x. xagua* (scale line = 1 mm): *Astraptetes xagua xagua* (SRS-701) a – tegumen, uncus and related structures – lateral; b – tegumen, uncus and gnathos – ventral; c – tegumen, uncus – dorsal; d – saccus – ventral; e – juxta – ventral; f – right valva, interior – lateral; g – left valva, interior – lateral; h – penis, cornutus- dorsal; i – penis, cornutus lateral. 14 a-i) Male genitalia *Astraptetes xagua harveyi* (PT) (SRS – 1196) a – tegumen, uncus and related structures – lateral; b – tegumen, uncus and gnathos – ventral; c – tegumen, uncus – dorsal; d – saccus – ventral; e – juxta – ventral; f – right valva, interior – lateral; g – left valva, interior – lateral; h – penis, cornutus- dorsal; i – penis, cornutus lateral.view.

Acc. 1994-12; 1♂ CUBA: SANTIAGO DE CUBA: Santa Maria dos Palmas 200m; 8.vii.1995 L. D. & J. Y. Miller, L. R. Hernandez, M. J. Simon; 1♂ CUBA: SANTIAGO DE CUBA: Parque Nac. Gran Piedra; 11-1200 m; cloud forest; 9.vii.1995, L. D. & J. Y. Miller, L. R. Hernandez, M. J. Simon; 1♂ CUBA: GRANMA: El Naranjo, Pico Torquino Nac. Park, 5.vii.1995, L. D. & J. Y. Miller, L. R. Hernandez, M. J. Simon; 2♀ CUBA: Guantanamo: U.S. Naval Base, Site 4, 19.9347, -75.0972, 19.i.2012, J. Toomey & R. Portell (LEP 34273, KY659600); 5♂, 2♀, MGCL 170981 (LEP-10545), 170982; Site 7, vic. Stephens Ave., 19.92296, -75.12894, 23.i.2012, nectaring on *Gliricidium sepium*, D. Matthews, R. Portell, J. Toomey, T. Lott; MGCL170977 (LEP-10542), 170983–170987 (1♂ 170986, LEP-10543, KY659601; 1♂ 170987, LEP10544, KY659602), 170989; Site 11, E of Sherman Ave., nr. Library, 19.91368, -75.139947, 21.i.2012, nectaring on *Bouganvillea*, D. Matthews; 2♀, MGCL 170979, 17980; Site 12, E. of Sherman Ave., 19.91661, -75.132414, 25.i.2012, nectaring on *Melochia tomentosa*, D. Matthews & T. Lott.

Diagnosis: Ground color dorsal wings blackish brown with basal third shiny cerulean blue and no hyaline spots on forewing. Ventral with forewing ground color black-brown on basal half, especially below cell, in Cu_2-2A and as a vague darker postdiscal band beyond and above discal cell; basal third shiny cerulean blue

above Cu_2 , reaching to origin of Cu , but does not reach white spots at mid-costa in costal cell. Hindwing: Similar mottled dark brown as forewing, but otherwise unmarked.

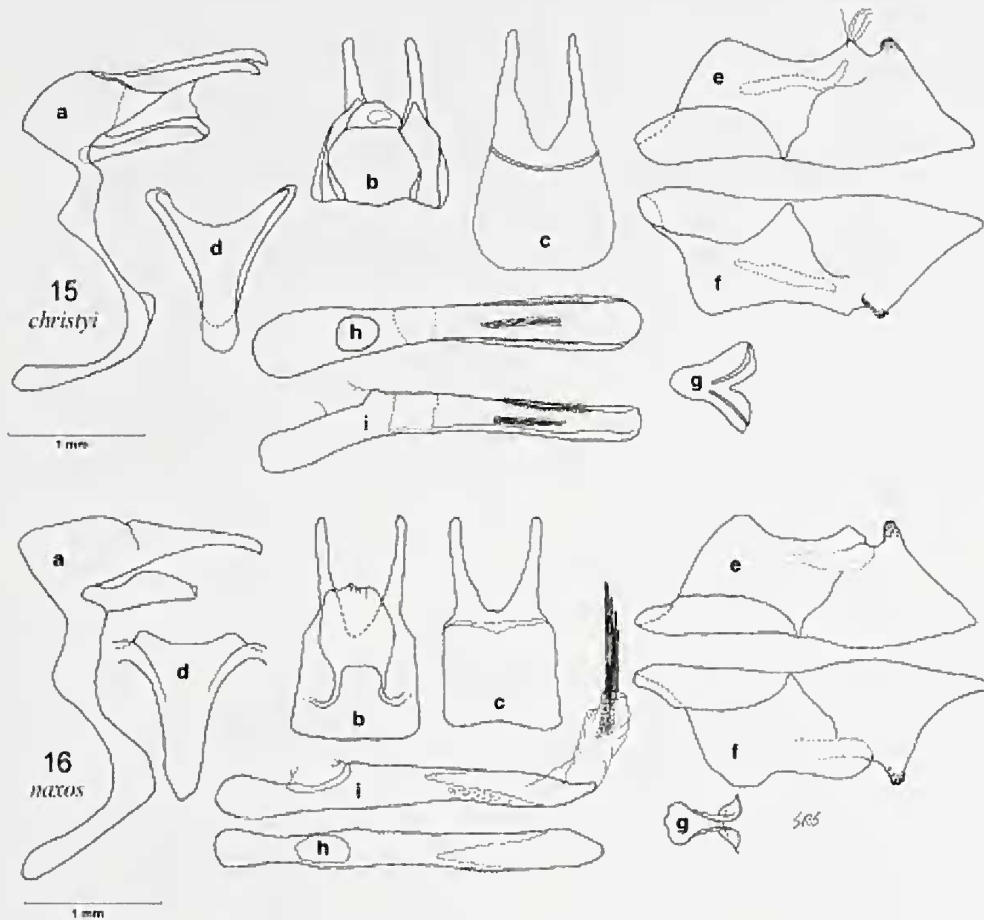
Distribution: *Astraptetes x. xagua* is only recorded from Cuba.

Astraptetes xagua harveyi H. Clench, S. R. Steinhauser, J. Y. Miller, sp. nov.

(Figs. 5-6 male HT; 14 a-i male genitalia; Female Paratype 7-8; female genitalia 18 a-b.)

ZooBank LSID: urn:lsid:zoobank.org:act:7690A568-0F9C-401B-8C10-DE8AFBA5A56F

In an unpublished manuscript, “Bahama Butterflies: Hesperiidae” (1979), Harry K. Clench provided the following very brief description of this subspecies (slightly edited here). However, we believe it is sufficient to credit him with its authorship: “This is the only hesperiid in the Bahamas [broadly] marked with bright, iridescent



Figures 15-16. (Scale line= 1 mm) 15 a-i) Male genitalia *Astraptetes christyi* (JYM-7649) a – tegumen, uncus and related structures – lateral; b – tegumen, uncus and gnathos – ventral; c – tegumen, uncus – dorsal; d – saccus – ventral; e – juxta – ventral; f – right valva, interior – lateral; g – left valva, interior – lateral; h – penis, cornutus- dorsal; i – penis, cornutus lateral. 16 a-i) male genitalia. *Astraptetes naxos* (SRS 1989) a – tegumen, uncus and related structures – lateral; b – tegumen, uncus and gnathos – ventral; c – tegumen, uncus – dorsal; d – saccus – ventral; e – juxta – ventral; f – right valva, interior – lateral; g – left valva, interior – lateral; h – penis, cornutus- dorsal; i – penis, cornutus lateral view.

blue [not green] (on the body, the bases of both wings above, and the base of the forewing below). Its large size (fw length 24-28 mm) and absence of tails will further distinguish it. The three subspecies of *xagua* are remarkably distinct from one another. Nominate *xagua* (Cuba) has no white marks upfw; of them, *x. christyi* (Hispaniola) has a diagonal median band, but no subapical spots; and *x. harveyi* has three or four subapical spots, but only a subcostal spot representing the diagonal band.”

We have expanded this description as follows:

MALE: Forewing averaged 24.5 x 13.0 mm (n=3), range 24 x 13 (holotype) to 25 x 13 mm.

Dorsal: Forewing round color is similar to *A. x. xagua*, but blue area is enlarged to cover nearly half of the forewing and more diffuse distad. There are three to four pre-apical white spots in R_3-R_4 , R_4-R_5 and R_5-M_1 in a line directed to midway between apex and mid termen with a single white central hyaline upper cell spot. The basal

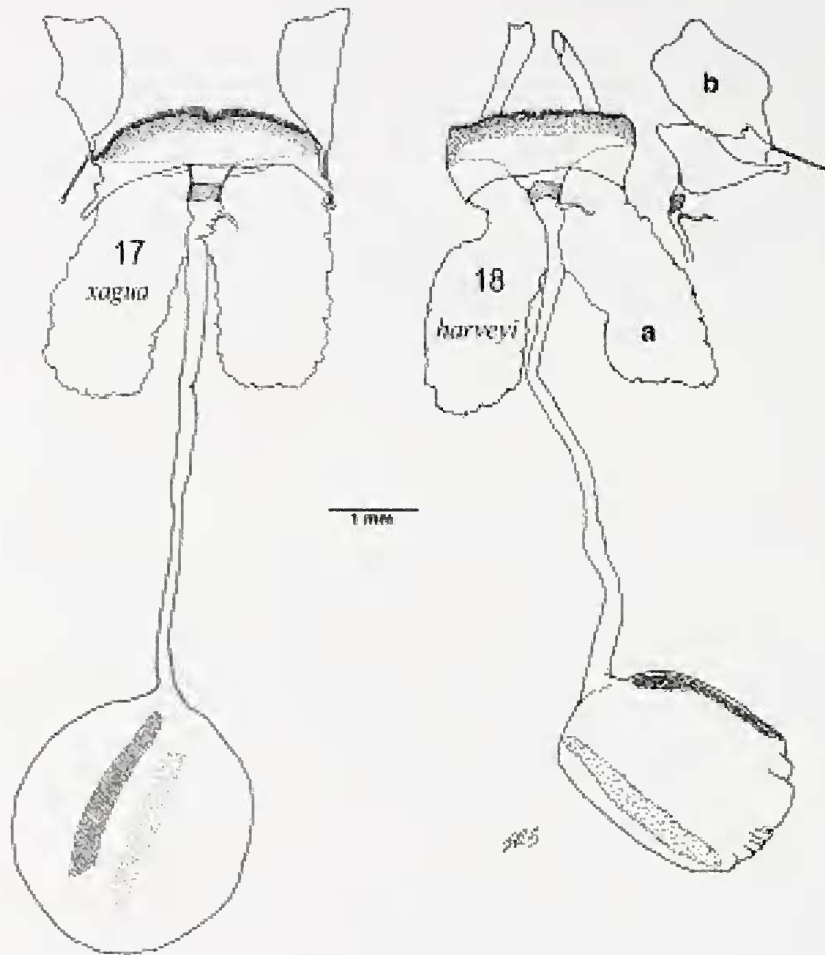
blue area reaches beyond cell spot, covering about half the wing. Hindwing as in *A. x. xagua*.

Ventral: Forewing slightly paler brown than above, much paler in anal cell, somewhat darker at base in basal nine tenths of Cu_2-2A and bearing a darker brown postdiscal band similar to that of *A. x. christyi*, but more prominent. Basal blue reaches origin of vein M_3 , and is present in central Cu_2-2A . White spots as above with additional opaque pre-apical spot in R_2-R_3 , and mid costal opaque spots in costal cell and $Sc-R_1$ enlarged; lightly overscaled whitish sprinkled with a few shiny blue setae near apex in Cu_2-2A . Hindwing basal two thirds same dark brown basad as in discal area of forewing with an irregular distal margin; outer third distinctly paler brown posteriorad of R_s and may be dentate above $2A$. Fringes concolorous.

Head, thorax, legs and abdomen as in *xagua*; antennal nudum 7/21 in holotype, 7/20 in one paratype with complete antennae.

Genitalia: (Figs. 14 a-i) as *A. x. xagua*; the process of the cucullus projects dorsally with few spicules; juxta is reduced and morphologically distinct.

FEMALE: Slightly larger, paratypes measured 27 x 14 and 28.5 x 15 mm (n=2),



Figures 17-18. (Scale line= 1 mm) 17 a) Female genitalia *Astraptes x. xagua* (SRS 702) ventral view, sterigma flattened, 18 a-b) Female genitalia *Astraptes xagua harveyi* (SRS 1197) a) ventral view; b) papilla analis, lateral view.

Dorsal forewing pre-apical white spot in R_2 - R_3 and upper cell spot slightly larger. Hindwing as male but rounder. Shiny cerulean blue somewhat paler. Antennal nudum 7/21 and 9/21 in two female paratypes.

Ventral: As in male, but forewing central costal spot enlarged and extends across cell.

Genitalia (Figs. 18 a-b): As in *A. x. xagua*.

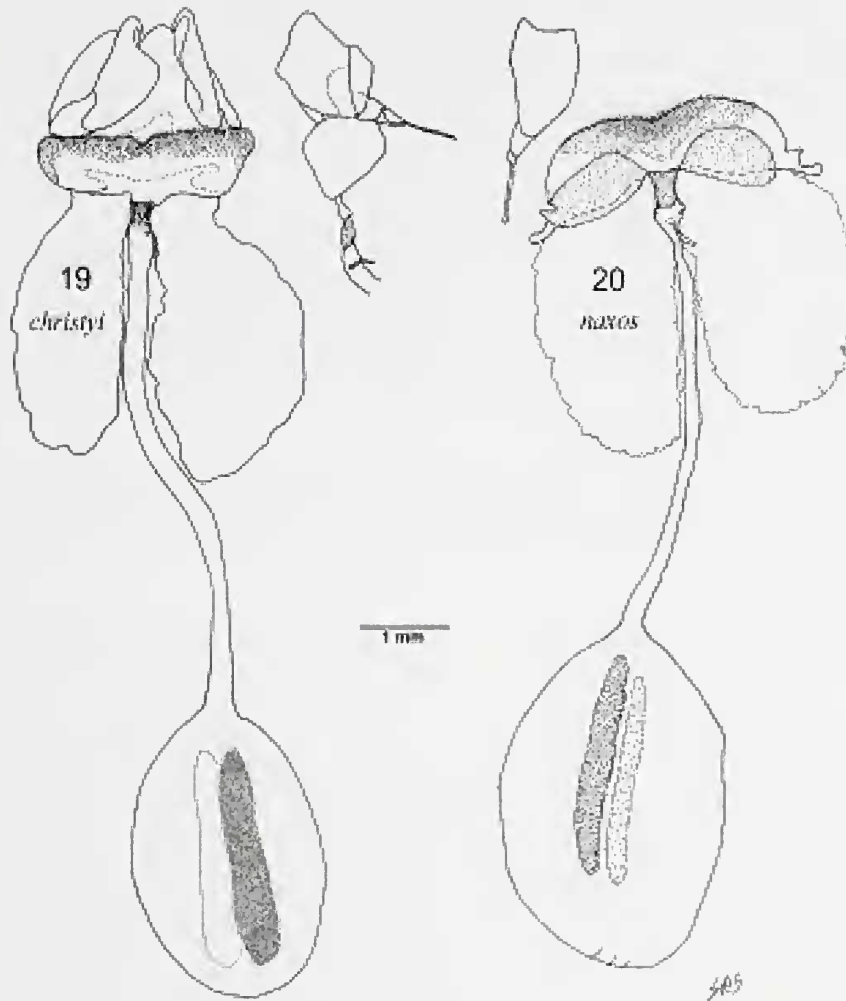
Etymology: The late Harry K. Clench proposed the name, *Astraptes xagua harveyi*, for this striking skipper, after its discoverer, Dr. Donald J. Harvey, but the description was not published before his untimely death in 1979. That omission is corrected here with this posthumous description and publication.

Types: Holotype male from Bahamas: North Andros Island; Nicolls Town; 11.viii.1976; leg D. Harvey, deposited in the Carnegie Museum of Natural History and bearing the following labels: printed and hand printed white label NORTH ANDROS: Nicolls Town 11.viii.1976; printed white label - BAHAMA IDS leg. D. Harvey; printed and hand printed red label- HOLOTYPE No. 684 Carn. Mus. Ent.; printed and hand printed red label- HOLOTYPE (male symbol) *Astraptes xagua harveyi* H. Clench; printed and hand printed white label - Allyn Museum Photo No. 990909-17A, 18A. Another red label has been added: Holotype ♂/ *Astraptes/xagua harveyi*/H.Clench, S. R. Steinhauser/J.

Y. Miller. There are two male and two female Paratypes: 1♂ Bahamas: North Andros Island; nr. Nicholls Town, 10 August, 1980, leg. J.D. Weinraub (LEP-34272, KY659598), deposited in the Allyn Museum of Entomology (MCGL); 1♂ same data as holotype, 12.viii.1976; 1♀ same data 15.viii.1976, D. Harvey (LEP-34276, KY659599; JYM gen 7651) and 1♀ Bahamas: North Andros Is., Nicolls Town, Sta. 182; 22.xi.1973 leg H.K. Clench (LEP-34149, KY659597; SRS gen 1197); the latter three specimens are deposited in the Carnegie Museum Natural History.

Diagnosis: *A. xagua harveyi* can be easily distinguished from nominate *A. x. xagua* by the presence of the dorsal four white pre-apical forewing spots and the white mid costal across the forewing cell approximately one half distance to cell end. On the ventral surface, the white forewing markings are enlarged and there is a marked difference in the darker rich brown coloration basad with paler brown along the submarginal areas of both wings.

Distribution: Voucher specimens of *Astraptes xagua harveyi* are only known from North Andros Island in the Bahamas thus far, but apparently Clench in his notes observed it on South Andros as well. The type series was only collected in Nicolls Town on North Andros. Despite extensive searches in that location by several collectors (L. D. and J. Y. Miller, M. Simon, G. Goss, R. Rozycki, D. Matthews) in recent years, no further specimens have been observed. In 1994



Figures 19-20. (Scale line= 1 mm) Figs 19 a-b) Female genitalia *Astraptus christyi* (JYM 7648) a) ventral view; b) papilla analis, lateral view. 20 a-b) Female genitalia *Astraptus naxos* (SRS 774) a) ventral view; b) papilla analis, lateral view.

L. D. Miller saw a specimen across from the dense forest at AUTECH (Atlantic Undersea Test and Evaluation Center) on the southern area of N. Andros with another specimen observed by Rick Rozycki in that location in 2012. Mark Simon observed three specimens along a dense xeric tropical forest near Stanyard Creek, but we have not seen this species elsewhere on the island. It has not come to blacklight or mercury vapor light, and we have attempted collecting for it very early in the morning and late at night. We have not observed this species elsewhere in the Bahamas despite our ongoing collecting efforts on other major islands.

Astraptus christyi (Sharpe, 1898), **reinstated status** J. Y. Miller & N. Grishin
(Figs. 9-10 male; male genitalia 15 a-i; female genitalia, 19 a-b)

Telegonus christyi Sharpe, 1898
= *Thymele angustus* Skinner, 1920

MALE: (Figs 9-10) Dorsal: Forewing averaged 26.33 x 13.94 mm (n=9) range 25.5 x 13 to 27 x 14.5 mm (holotype 27 x 14 mm);

Dorsal: forewing similar to *A. xagua*, ground color blackish brown paler on the distal half of forewing with forewing apex more acute; narrow central hyaline white band extending from mid costa at end of costal fold to near tornus in Cu_2-1A , comprising spots in costal cell (often opaque), $Sc-R_{1+2}$ discal cell, Cu_1-Cu_2 and a small triangular spot in Cu_2-1A ; no pre-apical spots. Shiny cerulean blue on basal forewing and broader than in *xagua*. Coloration of hindwing dark blackish brown with shiny cerulean blue extends to almost one half of the wing near cell; shape of wing is considerably broader than in *xagua*.

Ventral: Ground color of forewing dark brown at base, paler brown distad; hyaline band broader than above and extends almost to the tornus; basal blue area reaches central band except in costal cell, darker basal area extending posteriorly to anal margin which is sparsely sprinkled with a few cerulean blue scales as in *A. x. harvayi*. Hindwing darker brown at base overscaled faintly with blue scales at base and angled sharply at $Rs-M_1$, arched basally and then fused to a point in Cu_2-2A ; submarginal area paler brown. Fringes concolorous.

Key to the taxa of *Astraptles xagua* complex

| | |
|--|----------------------|
| UPF plain, without white spots..... | <i>xagua</i> |
| 1' UPF with white spots..... | 2 |
| UPF with complete hyaline white transverse band, without pre-apical spots..... | <i>christyi</i> |
| 2'. UPF with white spot mid costa and three pre-apical spots..... | <i>xagua harveyi</i> |

Head, thorax, abdomen above as in *xagua*; ventral with fuscous to beige on midthorax to first abdominal segment as opposed dark blackish brown of mesothorax, metathorax, and abdomen in *A. x. xagua* and *A. xagua harveyi*; legs brown with fuscous/beige line along distal margins. Antennal nudum averaged 26.25 segments (n=8), range 25 to 27 with six to seven segments on the club.

Genitalia: (Figs 15 a-i) Uncus similar to *A. x. xagua* but more elongate with anterior margin of tegumen smooth as opposed undulate in *A. christyi*. Valvae asymmetrical with lighter sclerotized bar ventral of costal margin reduced; ampula with elongate setae and process of cucullus spinose; posterior of cucullus blunt as in *A. naxos* as opposed to acute in *A. x. xagua* and *A. xagua harveyi*; interior margin of valvula extending toward the process of the cucullus roughly sclerotized and curved similar to some members of the *fulgurator* complex. Aedeagus with dorsal margins spiculate and number of cornuti markedly reduced.

FEMALE: Coloration and markings as male but slightly larger; forewing averaging 29.40 x 15.30 mm in (n=10) from 28 x 14.5 to 30 x 16 mm

Hindwing more rounded. Antennal nudum averaged 26.33 segments (n=9) range from 25 to 28, with six to seven segments on the club.

Genitalia: (Figs. 18 a-b): General configuration is similar to that of *A. x. xagua* and *A. x. harveyi* with the distal margin of postvaginalis more heavily sclerotized shading lighter toward the antevaginalis; postvaginalis with more prominent undulate margin midway on posterior postvaginalis and with erect setae and scales more elongate centrad; corpus bursae more bulbous with signa heavily spiculate similar to those of *A. x. xagua*, *A. xagua harveyi*, and *A. naxos*.

Specimens examined. Dominican Republic: La Vega: Jarabacoa, Pine forest 1800 m. 22.vii.1986, D. Matusik; same but 1♂, 1♀ 21.vii.1986; 1♂ 24.vii.1986; 1♂ 26. vi, 1♂ 30.vi, 1♂ 1.vii.1986; 1♂, 1♀ Dominican Republic: La Vega: Jarabacoa, 18 July 1986, specimen no.530 M ex Gonzalez (♂ LEP-34271, KY659594); 1♂ 19 km S. Jarabacoa, La Vega Province, Dominican Rep., 23.vi.1986, T. C. Emmel; 2♂ 2 km SE Jarabacoa, (Constanza Rd), 1900 Ft. elev.; 1♂ La Vega Prov., Dominican Republic, Dec. 30 1985, T. C. Emmel; 1♂ Rep. Dominicana: La Vega, Jarabacoa (LEP-34274, KY659595) 1♂ 2 km SE Jarabacoa, (Constanza Rd), 1900 Ft. elev.; 1♂ La Vega Prov., Dominican Republic, J. L. Nation; 2♂ 6/22/1986 (♂ LEP-34275, KY659596); 1♂ on Constanza RD 6/24/1986; 1♂ DOMINICAN REPUBLIC, LA VEGA, Jarabacoa 1700 Ft. June 10, 1988, Louis Sanchez; Dominican Republic, Jarabacoa, 2/20/1985, Lowell Harris; DOMINICAN RREPUBLIC: La Vega: vic. Jarabacoa 620 m; 11.1.1987, L. & J. Miller Sta DR-16.

Diagnosis: The following features distinguish *Astraptles christyi* for elevation to species rank: 1) Presence of the transverse white hyaline somewhat opaque band along with the absence of the apical markings; 2) More extensive cerulean blue on forewing and hindwing; 3) The extant and shape of the darker brown area on the hindwing especially the distal margin; 4) Coloration of ventral head, thorax and abdomen from the buff to yellow present on the palpi which extends down the mid-ventral thorax and on first abdominal segment; 5) Male genitalic features include differences in the valvae with the posterior margin of the cullier, process of the cullier, interior margin of the valve and the sparse number of cornuti; 6) Female genitalia indicate a close alignment with *A. xagua* with slight differences on the sterigma. These features in addition

to the analyses of *COI* data below indicate sufficient supportive evidence to reinstate *A. christyi* to species status.

Distribution: *Astraptles christyi* was originally described by Emily Sharpe for Dr. Cuthbert Christy in recognition of his field notes and collection efforts of Lepidoptera taken in 1896 on Hispaniola. *Astraptles christyi* is endemic to Hispaniola and thus far has generally been recorded from the Dominican Republic especially in La Vega Province (Schwartz 1989, Smith et al 1994).

COI barcode analysis and morphology of *Astraptles xagua* complex

The dendrogram (Fig. 21) resulting from our analysis of *COI* barcode sequences suggests that *A. xagua harveyi* and nominate *xagua* form a monophyletic group, and *christyi* is more distant from them. Continental Brazilian relative, *naxos*, was used as an outgroup. The Cuban samples (both Santiago and Guantanamo) have essentially identical barcodes with the Bahamian closely aligned to the Cuban group as a separate haplotype. *A. christyi* is separated from *xagua* by 2.5 % and this is supported by a number of morphological characters: presence of the transverse hyaline somewhat opaque band, absence of apical markings, wing shape more acute, increased expanse of blue on the base of the dorsal wings, shape of the outer margin of darker ventral hindwing postdiscal band margin, and coloration of the mid-ventral thorax, in addition to the male genitalia (differences in valvae in the development of process of the cullier, shape of the posterior cullier, and sparse number of cornuti). Nominate *xagua* has no dorsal wing markings whereas *x. harveyi* has prominent preapical spots. The barcodes suggest an accelerated rate of evolution in *x. harveyi* due to some special selection pressure.

There are currently six species of *Astraptles* recorded from the West Indies: *A. talus* (Cramer), *A. anaphus* (Cramer), *A. xagua* (Lucas), *A. cassander* (Fabricius), *A. habana* (Lucas), and *A. jaira* (Butler). *Astraptles talus* and *A. anaphus* are widespread in the West Indies and also found in Central America. *Astraptles cassander* is restricted to Cuba while *A. jaira* is found in Jamaica. *Astraptles habana* and *A. xagua* are restricted to Hispaniola and Cuba with *A. christyi* restricted to Hispaniola. *Astraptles x. harveyi* is only recorded on North and possibly South Andros in the Bahamas. *Astraptles xagua* and its subspecies are essentially the West Indian equivalents of *A. fulgurator*, *fulgor*, and *naxos* on the continents. Given the

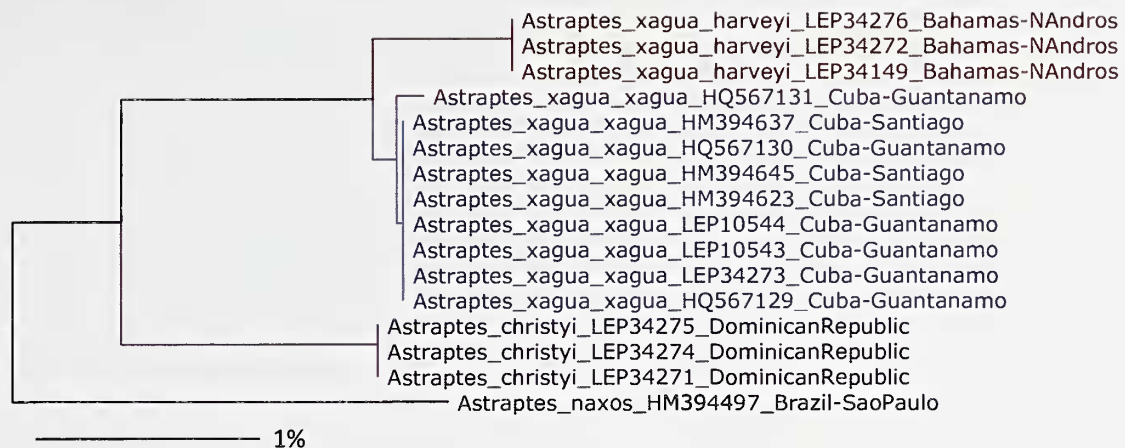


Figure 21. COI DNA barcode distances dendrogram for *Astraptes xagua* complex, *A. christyi*, and *A. naxos*. Species name, voucher code and general locality are shown for each specimen. Sequences with voucher codes starting from “LEP” were obtained in this work, others are GenBank accessions. Scale bar shows 1% sequence divergence.

diversity of cryptic species in the genus *Astraptes*, further morphological and molecular studies are required.

ACKNOWLEDGEMENTS

We are greatly indebted to many people and institutions who have aided us by providing loans and distribution records for this study including the following: Philip Ackery and Richard I. Vane-Wright, Natural History Museum, London, the late Frederick H. Rindge, American Museum of Natural History, New York, John Rawlins and Chen Young, Carnegie Museum of Natural History, Pittsburgh, PA, Sue Borkin, Milwaukee Public Museum, John M. Burns and Don Harvey, National Museum of Natural History (Smithsonian Institution), Julian P. Donahue then at Natural History Museum of Los Angeles, Dr. H. J. Hanneman, Museum für Naturkunde der Humboldt-Universität, Berlin and Dr. Wolfgang Dierl, Zoologische Staatssammlung, München. We also thank M. Bernard Hermier for his assistance on providing photographs of some types and Ernst Brockmann for assembling a large library of Hesperiidae COI barcode sequences and most generously sharing it with us. We thank the late Lee D. Miller for his insight on various matters and our field team (M. J. Simon, Gary Goss, Deborah Matthews, Rick Rozycki) for their invaluable assistance in so many ways. J. Y. Miller would like to thank Andy Warren and Deborah Matthews for their discussions in bringing this publication to completion. Very special thanks are due to D. Matthews for her invaluable assistance in completing the plates and figures for this publication.

EDITOR'S NOTE

The electronic edition of this article has been registered in ZooBank to comply with the requirements of the amended International Code of Zoological Nomenclature (ICZN). This registration makes this work available from its electronic edition. ZooBank is the official registry of Zoological Nomenclature according to the ICZN and works with Life Science Identifiers (LSIDs). The LSID for this article is: urn:lsid:zoobank.org:pub:369615DC-F4A3-45D5-A45C-DC09A9A28A3E Registration date: 25 March, 2017. This record can be viewed using any standard web browser by clicking on the LSID above.

LITERATURE CITED

- BROWER, A. V. Z. 2005. Problems with DNA barcodes for species delimitation: 'ten specis' of *Astraptes fulgurator* reassessed (Lepidoptera: HesperIIDae). *Systematics and Biodiversity* 4(2): 127-132.
- GLENCI, H. K. 1977. A list of butterflies of Andros, Bahamas. *Annals of the Carnegie Museum* 46:173-194.
- GLENCI, H. K. 1979. Bahama Butterflies: HesperIIDae. Unpublished Manuscript.
- CONG, Q. & N. V. GRISHIN. 2014. A new *Hermueptychia* (Lepidoptera, Nymphalidae, Satyrinae) is sympatric and synchronic with *H. sosybius* in southeast US coastal plains, while another new *Hermueptychia* species – not *hermes* – inhabits south Texas and northeast Mexico. *Zookeys* 379: 43-91.
- CRAMER, PIETER [1775-1782]. *De uitlandische Kapellen voorkomende in de drie Waereld-Deelen Asia, Africa en America. Papillons exotiques des trois parties, du monde l'Asie, l'Afrique et Amerique.* Amsterdam, S. J. Baalde; Utrecht, Barthelemy Wild and J. Van Schoonhoven & Comp. 4 vols.
- EVANS, W. H. 1952. A catalogue of the American HesperIIDae in the British Museum (Natural History) Part 2: Pyrginae The British Museum (Natural History) and B. Quaritch, London: v + 178pp., pls.10-25.
- HEBERT, P. D. N., E. H. PENTON, J. M. BURNS, D. H. JANZEN, & W. WALLACIS. 2004. Ten species in one: DNA barcoding reveals cryptic species in the neotropical skipper butterfly, *Astraptes fulgurator*. *Proceedings of the National Academy of Sciences of the USA* 101:14812-14817.
- HERRICH-SCHAEFFER, G. A. W. 1862-1863. Schmetterlinge aus Cuba. *Correspondenz-Blatt des zoologisch-mineralogischen Vereines in Regensburg* 16:118-120, 141-143, 156-157, 174-180 (1862); 17:138-143 (1863).
- HEWITSON, W. C. 1867. Descriptions of one hundred new species of Hesperidae. London, John Van Voorst, lxxi +25 pp.
- HUBNER, J. 1806-1838. *Sammlung exotischer Schmetterlinge.* Augsburg.
- HUBNER, J. 1816-1826. *Verzeichniss bekannter Schmettlinge [sic].* Augsburg: 431pp.
- LINDSEY, A. W. 1925. The types of hesperioid genera. *Annals of the Entomological Society of America* 18(1) 75-106.

- KLOTS, A. B. 1956. 20. Lepidoptera. S. L. Tuxen (Ed.) Pp. 97-111
Taxonomist's glossary of genitalia in insects. Ejnar Munksgaard,
Copenhagen.
- LUCAS, P. H. 1857. Ordre des Lepidopteres In de la Sagra, Histoire
physique, politique, et naturelle de l'Isle de Cuba. Paris.
Animaux articles 7: 474-750.
- MATTHEWS, D. L., J. Y. MILLER, T. A. LOTT, R. W. PORTELL, & J. K.
TOOMEY. 2012. Biogeographical affinities of Guantanamo
butterflies and report on species recorded from the United
States Naval Base, Cuba. Bulletin of the Allyn Museum 164:
1-51. 83 figs, 1 pl.
- MIELKE, O. H. H. 2005. Catalogue of the American Hesperioidea:
Hesperiidae (Lepidoptera). Volume 2 Pyrginae 1: Eudamini.
Sociedade Brasileira de Zoologia, Curitiba: 129-410
- MILLER, L. D. 1970. Nomenclature of wing veins and cells. Journal
of Research on the Lepidoptera 8(2): 37-48.
- PELHAM, J. P. 2008. A Catalogue of the Butterflies of the United
States and Canada with a complete bibliography of the
descriptive and systematic literature. The Journal of Research
on the Lepidoptera vol. 20. 652 pp.
- SCHWARTZ, A. 1989. The butterflies of Hispaniola. University of
Florida Press, Gainesville, Florida. 580 pp.
- SHARPE, E. M. B. 1898. On a collection of lepidopterous insects from San
Domingo, with field-notes by the Collector, Dr. Cuthbert Christy.
Proceedings of the Zoological Society of London 1898(3): 362-369.
- SKINNER, H. 1920. Descriptions of new species of Hesperidae.
Entomological News 31(5): 132-135.
- SMITH, D. S., L. D. MILLER, & J. Y. MILLER. 1994. The butterflies of
the West Indies and south Florida. Oxford University Press,
Oxford 264 pp. 32 pl.
- STEINHAUSER, S. R. 1986. A review of the skippers of the *nanosius*
group of species of the genus *Astraptes* Hubner (sensu Evans,
1952) and erection of a new genus. Lepidoptera: Hesperidae.
Bulletin of the Allyn Museum 104: 1-43, 79figs.
- STEINHAUSER, S. R. 1989. Taxonomic notes and descriptions of new
taxa in the Neotropical Hesperidae. Part I, Pyrginae. Bulletin
of the Allyn Museum 127: 1-70, 109 figs.
- WARREN, A. D., J. R. OGAWA, & A. V. Z. BROWER. 2009. Revised
classification of the family Hesperidae (Lepidoptera:
Hesperioidea based on combined molecular and morphological
data. Systematic Entomology 34: 467-523.
- WILLIAMS, R.C., JR. & E. L. BELL. 1933. Studies in the American
Hesperioidea (Lepidoptera) Paper I. Transactions of the
American Entomological Society 59: 69-84, 1 pl.